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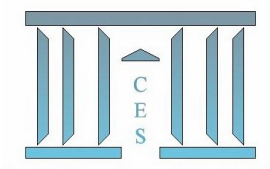

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Are perceptions and preferences channels of transmission for social inequalities in breast cancer screening attendance?

Léontine Goldzahl*†

Abstract

Three broad types of explanations can be found relative to breast cancer screening attendance: socioeconomic characteristics (education), preferences (e.g. attitude toward risk) and perceptions. These determinants are elicited in the experimental laboratory on 178 women aged between 50 and 75 years old. By performing a mediation analysis, this study aims at identifying the main drivers of screening regularity, as it is a crucial determinant of breast cancer mortality reduction. Results show that socioeconomic determinants (both from parents and the individual) have a strong impact. Women whose mother passed compulsory education are more likely to hold a degree and to be risk tolerant and hence to screen regularly. Even if more educated and richer women tend to screen more regularly, these effects are lowered once perceptions are controlled for. Indeed, almost all respondents overestimate their risk of developing breast cancer, but the less educated respondents do so even more.This study reveals that risk preference is a channel for opportunity inequalities. On the contrary, controlling for risk and benefit perceptions tend to alleviate the role played by current socioeconomic status.

JEL classification: D03; I18

Keywords: behavioral economics, cancer screening, social inequalities, perceptions, risk preference

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1 Introduction

This paper aims at better understanding the socioeconomic and psychological determinants of breast cancer (BC) screening regularity. Compliance to screening regularity guidelines, i.e. screening every two years, is a crucial determinant of BC mortality reduction. Promoting regular screening is especially relevant for BC because early diagnosis allows treatment at an earlier stage which induces better survival prognosis. Recent meta-analysis of controlled trails report that screening diminishes BC mortality by 15 to 21% (INCA (2006)) for women older than 50 years old. If 100 000 women screen regularly during 7 to 10 years, 150 to 300 death by BC would be prevented. Leive and Stratmann (2014) find an 11 % decrease in BC mortality since national program started in the US. In France, BC screening uptake remains stable since 2008 (52% in the national program and an additional 10% screen opportunistically) and health professionals report that screening interval differs from the recommendeded one.

Three main types of determinants can be brought out from the literature: socioeconomic characteristics, perceptions and preferences. Social inequalities of access to BC screening characterized by both educational attainment and income, are the main explanations, given by health economists, of uptake rate differences between individuals (Carrieri and Wübker (2013), Devaux and Looper (2012), Jusot, Or and Sirven (2012) and Or et al. (2009)). In the psychological literature, risk perception (the probability of developing BC) and benefit perception (the probability of being cured if one has BC) are theoretical and empirical predictors of BC screening attendance (Katapodi et al. (2004) and Domenighetti et al. (2003)). A growing number of studies relate experimentally measured risk and time preferences to health behaviors such as smoking (Harrison, Lau and Rutström (2010), Chabris et al. (2008), and Anderson and Mellor (2008)), drinking (Sutter et al. (2013), Barsky et al. (1997)) and cancer screening (Picone, Sloan and Taylor Jr (2004)).

The relationship between risk preference and cancer screening remains ambiguous. Even though, theoretical models predict that risk aversion may under certain circumstances lead

to less diagnosis tests very scarce explicit empirical evidence are established. Besides, no studies have investigated the influence of parents characteristics in addition to the respondent's current social characteristics on BC screening. The level of effort invested in primary preventive care is driven by current and initial social characteristics (Tubeuf, Jusot and Bricard (2012)), so social background may also affect secondary preventive care consumption. But, socioeconomic characteristics, perceptions and preferences cannot be considered as independent. Conflicting evidence on the sign of the relationship between perceptions and educational attainment are reported in the literature (Katapodi et al. (2004)and Carman and Kooreman (2014)). Parents' characteristics are found to influence their offspring's preferences and educational attainment (Dohmen et al. (2012)).

A structural model would be finer to consider the relationship of these determinants and their influence on BC screening. But as the relationships are unclear, I decided to "ask the data". Mediation analysis developed by Breen, Karlson and Holm (2013) and Karlson, Holm and Breen (2012) does not require to formulate any hypothesis on the functional forms of these effects and are therefore used in this study. The literature suggests two complementary hypothesis of structure which are presented in figure 1. I first hypothesize that social background characteristics (i.e. parents characteristics) affect BC screening regularity although the effect could work through the current socioeconomic status and preferences. The second hypothesis concerns the influence of current socioeconomic status on BC screening regularity and how this relationship could be mediated by risk and benefit perceptions. To measure these determinants, data were generated in the experimental laboratory. The laboratory provided a setting where women aged between 50 and 75 years old completed a questionnaire including real incentivised tasks to elicit risk preferences with available assistance.

This study confirms the existing literature on the positive association between education, risk and benefit perceptions on BC screening and provide new evidence on the positive relationship between risk tolerance and cancer screening. Mediation analysis reveals that social background conditions are working through current socioeconomic status and risk prefer-

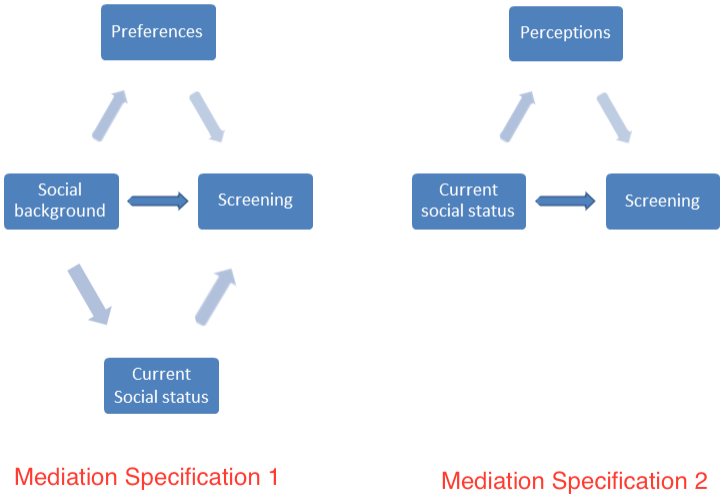

Figure 1: Relationships between social inequalities, preferences and perceptions

ences. Educated mother tend to have more risk tolerant and educated daughters who therefore screen more regularly. However, the effects of socioeconomic characteristics are mediated by perceptions. While low educated women screen less regularly, they also overestimate their risk more than women who hold a degree. This "pessimism" may have a protective effect. These results do not imply that causal inference are made but our rich set of controls should go a long way to palliate some omitted variable bias.

The remainder of the paper is organized as follows. Section 2 provides detailed literature review on BC screening determinants. Section 3 presents the econometric strategy. Section 4 describes how data were collected and how each determinant is measured. Section 5 reports the empirical results and section 6 discusses them and concludes.

2 Socioeconomic and psychological determinants influence on BC screening

2.1 Social background characteristics

Trannoy et al. (2010) look at the long-lasting effect of parents' characteristics on health status of their offspring in adulthood. They find that mothers' socioeconomic status (characterized by occupational status) has a direct effect on their descendant health status whereas their father's occupational status has an indirect effect on their descendant socioeconomic status. Parent's longevity also influence their descendants' health status In Bricard and Jusot (2012) smoking trajectory is related to parents' smoking behavior and socioeconomic status characterized by their occupation and educational attainment. But, social background influence not only health (genetic transmission) and health habits but also socioeconomic characteristics. Persistence across generations of income, educational attainment and occupation are reported by the OECD report (d'Addio (2007)) evaluating the inter-generational transmission of social characteristics. This is all the more important given that socioeconomic characteristics are relevant to BC cancer screening attendance: after controlling for needs, Carrieri and Wübker (2013) find that in many European countries including France, strong pro-wealthy and pro highly educated inequalities exist with respect to BC screening (also in Devaux and Looper (2012) and Or et al. (2009)). Jusot, Or and Sirven (2012) report that the chance of getting BC screening in the past two years is on average 1.5 times higher for women on the highest income group compared to those in the lowest one.

Inequalities of access to screening can be induced by difficulties of access to general practitioners (GP) and specialists doctors (SP). As specified in the Medical Convention in the article 12.42 of 2011 signed by GP, advising their patients to get screened for BC is part of their responsibilities. Even though specialist doctors (SP) are not formally asked to advise their patients to screen, gynecologists are very likely to do so. Duport and Ancelle-Park (2006) find that having had a gynecological examination in the previous 2 years is positively

associated with the use of mammography. But access to SP is still highly inequitable compared to access to GP in France (Dourgnon (2013)). Access to health care conjointly depends on how much of their expenses will be covered by the national health insurance system and how much will be covered by their private health insurance if they have one. The better their insurance coverage the more likely they are to undertake cancer screening (Hsia et al. (2000) for example).

Being objectively at risk i.e. with family history of BC is supposed to be an important positive determinant of BC regular attendance. However, Kash et al. (1992)Kash et al. (1992) provide evidence that women with family history of BC tend to avoid screening.

2.2 Perceptions

Perceived risk is one's perception of their risk of developing BC and perceived benefit corresponds to the likelihood of surviving if one has BC. Perceived risk is introduced as an important predictive variable of preventive care utilization in health psychology theories (Health Belief Model Rosenstock, Strecher and Becker (1988) and Theory of Planned Behaviors Ajzen (1985)). Perceived risk is generally considered protective, as people who perceive to be at risk are more likely to consume preventive care which may protect them (Eaker, Adami and Sparén (2001) and Katapodi et al. (2004)). A recent theoretical paper by **?** look at the impact of risk perception on primary and tertiary prevention consumption. They distinguish between pessimists and fatalists and show that only the pessimists increase their prevention level, however the model setting does not consider screening cases.

Assessments of BC screening benefits includes trust in the test itself (if mammography is effective to detect cancer) and trust in cure (if medicine and surgery work well enough to be cured). This paper deals with the second aspect. Some studies argues that it influences positively screening behaviors (Champion (1999)). But effective treatment can improve survival of non-screen detected cancers (interval cancers) and might reduce the gap in survival between screen-detected and interval cancers. Availability of modern treatment may then

decrease the perceived benefit of regular screening. The negative impact of financial cost is acknowledge in health studies (Lerman et al. (1990)). The French screening system is quite specific such that positive price may come from different sources (more detailed explanations are available in appendix B).

2.3 Preferences

Heterogeneity in time preferences would lead to different decisions over future consumption of health care. Mammography can potentially lower the probability of bad health conditioning on surviving. But having a mammography may induce immediate financial, physical and psychological costs. A future-oriented person should be more likely to engage in mammography consumption since they value the future benefits of this consumption more than its present costs. Picone, Sloan and Taylor Jr (2004) use the Health and Retirement Survey to analyze the effect of time preference (measured by a financial horizon question) on cancer screening. They find that long term horizon people are more likely to get mammography compared to short term horizon ones. Fang and Wang (2010) also use the Health and Retirement Survey to investigate the effect of time preference on mammography use based on a discrete choice model. They find that being present biased induces a lack of mammography use.

Studies focusing on the relationship between risk preference and preventive behaviors find that risk seeking is significantly related to being a current smoker, heavy drinking, being overweight or obese, and seat belt non-use (Jusot and Khlat (2013), Anderson and Mellor (2008)). All of them correspond to primary preventive care actions, aiming at diminishing the occurrence of a disease whereas one may expect a different influence of risk preference for secondary preventive care actions since they aim at detecting a potentially mortal disease with heavy treatment costs. The relationship between risk aversion and optimal preventive care consumption is ambiguous as depicted in theoretical papers by Chiu (2000), Briys and Schlesinger (1990), Dionne and Eeckhoudt (1985) and Picone, Sloan and Taylor Jr (2004).

Some concludes that under certain circumstances or assumptions, risk averse individuals are less likely to undertake diagnostic test than more risk tolerant individuals. No clear empirical evidence reporting an effect of risk preference on cancer screening was found yet.

An expanding part of the literature concentrates on the inter-generational transmission of socioeconomic and health status. Bowles and Gintis (2002) suggest that part of the explanation could be found in the inter-generational transmission of attitudes and preferences. The hypothesis is supported by recent empirical research documenting correlations between children and parents in the propensity to take risks (Dohmen et al. (2012)). They explain the inter-generational transmission of risk preferences by cognitive ability and educational attainment of parents : risk preferences could be shaped by parents' social characteristics. Schildberg-Hörisch et al. (2014) found a positive relationship between higher education and income of parents and more patient and less risk seeker offspring. One canno't ignore that education may also impact time and risk preferences, but these relationships are not developped in this study.

3 Econometric strategy

3.1 Probit model

The relationship between BC screening regularity, socioeconomic and psychological variables may be modeled such as:

$$Y = f(B, E, D, X, P, e) \tag{1}$$

The declared regularity of screening Y is a binary variable and is observed for every individual. Variable B represents a vector of social background characteristics. Variable E is a vector of current social characteristics. Vector X stands for perceptions. The vector of demographic and medical consumption characteristics D. The vector P captures individual preferences over risk and time. Finally, the residual term e is the unobserved heterogeneity which cannot

be accounted for by observed determinants. If determinants are introduced as independent variables, their relationship would be modeled as follows:

$$Y_i = \alpha B_i + \beta E_i + \delta D_i + \sum_{k=1}^{2}(\gamma_k.X_{k,i}) + \sum_{k=1}^{2}(\pi_k P_{k,i}) + e_i \tag{2}$$

with $i = 1, ..., N$ and $k = 1, 2$ is the subscript for each preference or perception. This model is estimated using a probit and will be referred to as the "full model".

3.2 Mediation identification

In opposition with the previous subsection 3, the interdependent relationships between the determinants are now accounted for in the two mediation specifications.

In the first mediation specification, the objective is to estimate the *total effect* of background social inequalities on BC screening regularity where the potential mediating variables effects via current social characteristics and preferences are captured by social background characteristics. Equation 3 represents this "reduced model" where mediating variables are left out:

$$Y_i = \alpha^{'} B_i + \delta^{'} D_i + \sum_{k=1}^{2}(\gamma_k^{'}.X_{k,i}) + \epsilon_{1,i} \tag{3}$$

The *total effect* of background social characteristics on BC screening is measured by $\alpha^{'}$ and its direct effect by α (in the "full model"). The difference between $\alpha^{'}$ and α is the *mediating effect* or *indirect effect* of social background characteristics on BC screening working through current social characteristics and preferences. However, those coefficients are not comparable in the case of non linear probability model (binary outcome variable). As explained in Kohler, Karlson and Holm (2011) and Karlson, Holm and Breen (2012) uncontrolled and controlled coefficients can differ not only because of the indirect effect of the independent variable on a mediating variable but also because of rescaling of the model that arises whenever the mediating variable has an independent effect on the outcome. It can be shown that the resulting estimators of social background characteristics in both models are $\frac{\alpha^{'}}{\sigma_r}$ for the

"reduced model" of equation 3 and $\frac{\alpha}{\sigma_f}$ for the "full model" 2. σ_r and σ_f are scale parameters which are function of the residual standard deviation of the underlying linear model. σ_r is greater than σ_f since adding a control mediating variable to the model reduces the unexplained part of the variance. Therefore, the difference between $\alpha^{'}$ and α would be affected by the difference between coefficients and the difference between scale parameters. Because the difference between these effects are confounded, estimating the indirect effect (i.e. difference in coefficients) requires not to distort the differences in scales. The solution provided by Karlson et al. (2011) is applied in this paper. The comparability problem can be overcome by using auxiliary equations and introducing the estimated residuals of these equations in the "full model" instead of the mediating independent variables. Then, coefficients would be comparable, purged from the rescaling difference. The auxiliary equations for each mediating variable are as follows:

$$\begin{aligned} E_i &= a_1 B_i + d_1 D_i + \sum_{k=1}^{2} (g_{k,1}.X_{k,i}) + w_{1,i} \\ P_{1,i} &= a_2 B_i + d_2 D_i + \sum_{k=1}^{2} (g_{k,2}.X_{k,i}) + w_{2,i} \\ P_{2,i} &= a_3 B_i + d_3 D_i + \sum_{k=1}^{2} (g_{k,3}.X_{k,i}) + w_{3,i} \end{aligned} \tag{4}$$

Auxiliary equations are all estimated using linear probability models. The "full model" (Eq 2) can then be rewritten as follows.

$$\begin{aligned} Y_i = \alpha B_i + \delta D_i + \sum_{k=1}^{2} (\gamma_k.X_{k,i}) + \beta(a_1 B_i + d_1 D_i + \sum_{k=1}^{2} (g_{k,1}.X_{k,i}) + \hat{w_{1,i}}) + \\ \pi_1(a_2 B_i + d_2 D_i + \sum_{k=1}^{2} (g_{k,2}.X_{k,i}) + \hat{w_{2,i}}) + \pi_2(a_3 B_i + d_3 D_i + \sum_{k=1}^{2} (g_{k,3}.X_{k,i}) + \hat{w_{3,i}}) + u_{1,i} \end{aligned} \tag{5}$$

Simplifying this expression provides:

$$Y_i = (\alpha + \beta a_1 + \pi_1 a_2 + \pi_2 a_3)B_i + (\delta + \beta d_1 + \pi_1 d_2 + \pi_2 d_3)D_i + \\ (\sum_{k=1}^{2} \gamma_k + \beta \sum_{k=1}^{2} g_{k,1} + \pi_1 \sum_{k=1}^{2} g_{k,2} + \pi_2 \sum_{k=1}^{2} g_{k,3})X_{k,i} + \beta \hat{w}_1 + \pi_1 \hat{w}_2 + \pi_2 \hat{w}_3 + u_{1,i} \quad (6)$$

Table I summarizes the decomposition of the direct and indirect effects going through mediating variables. Moreover, it differentiates the indirect effect of each mediator so that one can account for how much of the effect is going through each current social status characteristic, risk preference and time preference. The statistical inference is calculated using Sobel's method Sobel (1995). In the second mediation specification, the objective is to estimate the

Total effect	$\alpha^{'} = \alpha + \beta a_1 + \pi_1 a_2 + \pi_2 a_3$
Direct effect	α
Indirect effects	$\beta a_1 + \pi_1 a_2 + \pi_2 a_3$
via current social status	βa_1
via risk preference	$\pi_1 a_2$
via time preference	$\pi_2 a_3$

Table I: Decomposition of the effect of background social inequalities on BC screening

direct effect of current social characteristics and their indirect effects via risk and benefit perceptions. It works exactly like the first mediation specification and detailed econometric models are available in appendix A. Table II summarizes the decomposition of current social status effect on BC screening regularity.

Total effect	$\beta^{'} = \beta + \gamma_1 b_1 + \gamma_2 b_2$
Direct effect	β
Indirect effects	$\gamma_1 b_1 + \gamma_2 b_2$
via risk perception	$\gamma_1 b_1$
via benefit perception	$\gamma_2 b_2$

Table II: Decomposition of the effect of current social status on BC screening

4 The sample

4.1 Data collection

Data were obtained by means of a questionnaire survey using the experimental laboratory. The experimental sessions were run at the "*Laboratoire d'Economie Expérimentale de Paris*" (LEEP) and the Laboratory of Economics of the "*Ecole Polytechnique*" between June and October 2013. Both experimental laboratory are in the region Ile-de-France which includes Paris. Show-up fee is 20 euros, paid in cash at the end of the session with the additional earnings which depends on the lottery outcome.

The sample is restricted to female respondents aged between 50 and 75 years[1] which corresponds to the targeted age category of the screening program and who can then screen in the program and opportunistically. I exclude those respondents from the sample who have been diagnosed with BC, as after such a diagnosis, the need for health check-ups substantially changes. They do not make decisions on mammography use or any other preventive health care in the same way as others do. Four women declared they already had BC and therefore were excluded from the sample. Women who never got screened have an experience which differs from the one who at least got screened once. Ten women declared that they never have had BC screening and therefore were excluded from the sample. The final sample consists of 178 observations. Each observation is a woman between 50 and 75 years old who participated in the experiment and who indicated that she already has had BC screening at least once in her life. The following subsections decline how screening regularity and determinants are measured.

4.2 Breast cancer screening regularity

BC screening regularity is based on declared frequency of screening. It is the answer to the following question "How often do you screen for BC ?" Possible answers were every year,

[1]Eligibility to the screening program ends after 74 years old, so that women aged 75 years old could have participated in the program until a years ago maximum.

every two years, every three years, less than every three years, once in your life. A binary variable is constructed upon these answers. Almost 3 out of 4 (74.7%) women declared undertaking screening yearly or every two years (i.e. regularly).

4.3 Social background and current social status characteristics measures

Sample characteristics are available in table VII in the appendix C. The most relevant feature are that more than half of our sample went to university and half them have income that exceed 2500 euros per month.

4.4 Objective risk

The US National Cancer Institute (NCI) uses the epidemiological Gail model to provide women with objective risk estimation through their website. This BC assessment tool relies on a summary relative risk (family history, age, having children) and extra relative risk factors (mammographic density, race etc.) to give a probability of developing BC in the remaining lifetime. The survey only enable to fill the summary relative risk characteristics and hence remains a approximation of BC risk. It is a continuous variable displaying a percentage chance ranging from to 2.9 to 14.7%. The average is 6.4 which is under the national average risk of developing BC (8-10%).

4.5 Psychological variables

4.5.1 Perceptions

Answers to the following questions are respectively used to capture risk and benefit perceptions[2] "*What do you think your percentage chance of developing breast cancer in your lifetime is* ?" and "*What is your percentage chance of being cured if you had breast cancer in your*

[2]More details on perceptions measures are provided in appendix E

lifetime?". Figure 2 displays both perceptions distributions. There is a peak at 50% for both of them. It can either mean they think they have 1 chance over 2 to develop BC (or 1 chance over 2 to be cured) or it could also be interpreted as the ignorance of this probability or refusal to answer. If an individual answered 50% to both questions (only 4% of respondents did), it could be more assuredly interpreted as ignorance or refusal to answer. At the bottom right of the figure, the difference between risk perception and objective risk is depiscted. If this difference is negative, it means that the risk of developping BC is underestimated. This is true for 15% of the sample which conversely implies that 85% of them tend to overestimate their risk.

Financial barrier related to mammography use is captured by out-of-pocket expenses i.e. how much they pay the day of the exam. Almost half women in the sample (48%) believe that BC screening is free.

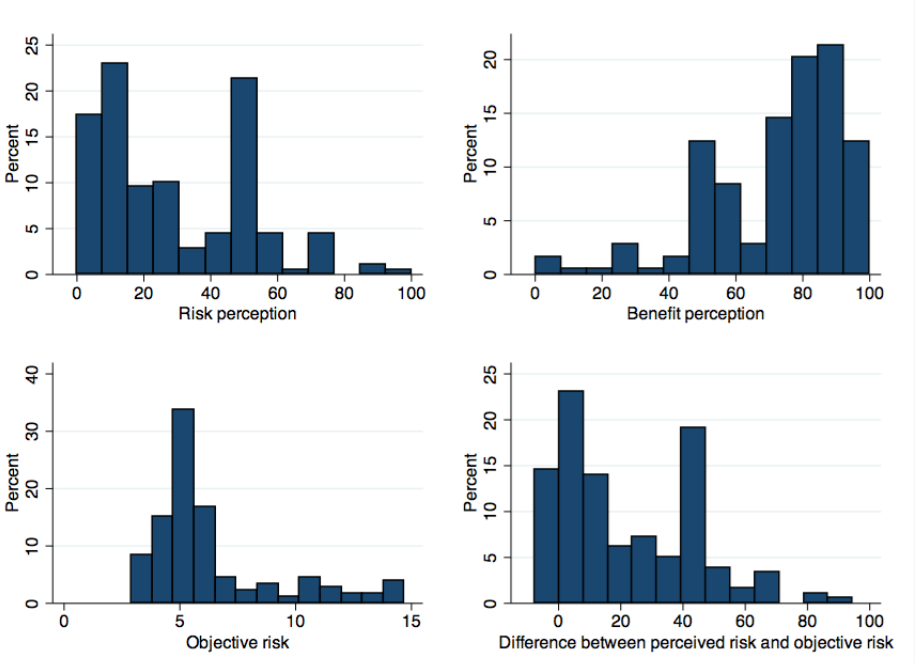

Figure 2: Distributions of objective risk, risk and benefit perceptions

4.5.2 Preferences

The selected measure to capture risk preference is a financially incentivised measures. Details on the choices of preferences measures are available in the Appendix D. I use Eckel et al. (2012)'s procedure since it is easier to understand for "computation averse" individuals as stated by Charness, Gneezy and Imas (2013). This 50/50 percentage chance lottery task consists on choosing one gamble among six possible gambles as displayed in figure III. This measure displays 6 circles, each on of them containing a gamble with a 50% percentage chance to win a high payoff or a low payoff. Payoffs start from 4.50 euros to 13.5 euros with an increment of 2 when increasing and 1 when decreasing. Each gamble allows an equal chance of winning a high payoff or a low payoff. As Eckel et al. indicated a higher return comes with higher variance when going clockwise. The first gamble represents certainty since one has an equal chance of wining 4.50 euros. Gamble 6 proposes a 50% chance to win 13.50 euros and a 50% chance to loose 50 cents (which supposedly looms larger because of loss aversion) so we can identify more risk-seeking individuals. Each subject has to choose only one gamble which is then played. Monetary gains are added to the show-up fee and given in cash at the end of the experiment. To summarize, the more the chosen gamble displays high payoffs the more variance in gains the subject is willing to accept so the more risk tolerant she is. This measure aims at classifying individuals relatively to each other according to their risk tolerance. Table III summarizes the lottery design. Option 1 corresponds to the gamble which displays equal gains of 4.5 euros which are added to the 20 euros show-up fee. Figure 4 displays the distribution of risk preference among the sample [3]. The variable is introduced as a dummy variable which equals 1 if the respondent is risk tolerant (chose option 4 to 6).

Time preference is measured using the Consideration for Future Consequences (CFC) scale created by Strathman et al. (1994). This psychological measure aims at capturing how people see themselves with respect to the future. The premise is based upon existing

[3]Up to date, this measure has only been used on teenagers so omparing results is not really meaningful to the study.

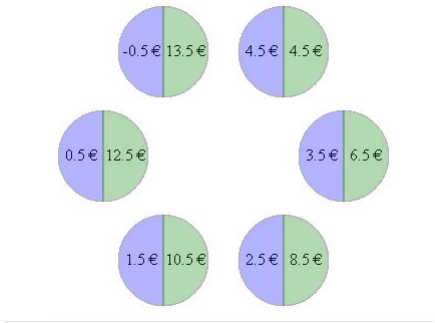

Figure 3: Lottery design

Options	Payoffs			Variance	N (%)
	Low	High	Expected Value		
1	24.5	24.5	24.5	0	17.5
2	23.5	26.5	25	2.25	13.3
3	22.5	28.5	25.5	9	11.2
4	21.5	30.5	26	20.25	12.8
5	20.5	32.5	26.5	36	16
6	19.5	33.5	26.5	49.25	29.2

Table III: Summary of lottery design

literature reporting that individual who are future oriented are believed to consider in their decision the link between their today's behavior and its future consequences. Future oriented individuals would be more likely to focus on goals and succeed more often in reaching them even if it means renouncing to immediate reward and differed satisfaction. Strathman's scale concentrates on the degree of consideration that individual have for potential long term as opposed to short term consequences of their actions. The shortened version of 8 items was used in this study. Each of the 8 items is followed by a 5 point scale on which people assert whether each one of the statements characterizes them. The obtained score is then divided by the number of items. A low score indicates that subjects display a tendency to focus on the future consequences rater than the immediate ones. Figure 4 presents the distribution of the CFC score in the sample. It is almost normally distributed around the mean score.

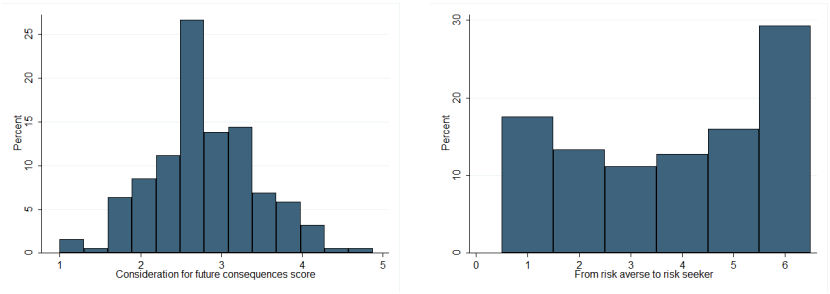

Figure 4: Consideration for future consequences score and risk preference distribution

5 Results

5.1 Full model estimations

The results of the full probit model (Eq 2) estimation are reported in column (1) of table IV. Direct social inequatlities are driven both by educational attainment and income although being an executive is negatively associated with regular screening (probably because of time constraint). No evidence of direct social background inequalities is found. Living in Paris diminishes the probability of a regular BC screening as suggested by the low uptake rate of screening observed in the capital city and the medical supply context. Relatively frequent visit to GP is related to regular screening. Regarding perception variables, the more one perceives to be at risk the more likely she screens regularly. Similarly, higher expectations about the chances of being cured is positively associated with regular screening.

Being more risk tolerant increases the probability to screen regularly. Cancer screening may lead to bad news with cancer diagnosis, heavy treatment with potentially lower life expectancy. The underlying psychological mechanism suggested is elaborated mainly in the theoretical literature depicting medical test avoidance. The eventuality of a bad news may generate anticipated anxiety or fear before the decision which leads individuals to avoid information (Kőszegi (2003) and Barigozzi and Levaggi (2010)). The risk becomes to be exposed to a bad news on one's life expectancy, hence risk tolerant individuals are more willing to take the risk of learning about their life expectancy. Following medical empirical

Variables	Full model (1) Screening regularity Coeff	SE	Full model Mediation 1 (2) Screening regularity Coeff	SE	Full model Mediation 2 (3) Screening regularity Coeff	SE
Age 50-54 (ref)						
55-59	0.840**	(0.373)	0.617*	(0.364)	0.837**	(0.373)
60-64	0.496	(0.400)	0.297	(0.379)	0.480	(0.399)
65-74	1.105**	(0.538)	0.570	(0.487)	0.842	(0.519)
Edu mother	-0.280	(0.296)	-0.0740	(0.272)	-0.343	(0.293)
Mother alive	0.0445	(0.299)	0.168	(0.297)	0.116	(0.299)
Father alive	0.0292	(0.353)	0.130	(0.355)	-0.0273	(0.352)
Education	1.383***	(0.359)	1.383***	(0.359)	1.127***	(0.334)
Income	0.503*	(0.289)	0.503*	(0.289)	0.362	(0.275)
Executive	-0.989**	(0.434)	-0.989**	(0.434)	-0.865**	(0.425)
Present oriented	-0.219	(0.211)	-0.219	(0.211)	-0.267	(0.210)
Risk tolerant	1.238***	(0.296)	1.238***	(0.296)	1.130***	(0.284)
Objective risk	-0.0867*	(0.0523)	-0.0762	(0.0502)	-0.0469	(0.0486)
2 to 4 visits to GP (ref)						
0 or 1 visit to GP	0.530	(0.350)	0.477	(0.343)	0.599*	(0.351)
5 + visits to GP	0.685*	(0.392)	0.436	(0.367)	0.748*	(0.393)
2 to 4 visits to SP (ref)						
0 or 1 visit to SP	-0.386	(0.277)	-0.458*	(0.275)	-0.549**	(0.279)
5 + visits to SP	-0.406	(0.433)	-0.353	(0.428)	-0.298	(0.429)
Chronic disease	-0.419	(0.315)	-0.374	(0.302)	-0.517	(0.318)
Health insu	-0.107	(0.163)	-0.0213	(0.161)	-0.0731	(0.163)
Paris	-0.689**	(0.301)	-0.587**	(0.295)	-0.717**	(0.302)
Risk perception	0.0234***	(0.00721)	0.0147**	(0.00653)	0.0234***	(0.00721)
Benefit perception	0.0145**	(0.00636)	0.00869	(0.00581)	0.0145**	(0.00636)
Free	0.149	(0.280)	0.375	(0.277)	0.114	(0.278)
Constant	-0.887	(1.394)	0.224	(1.192)	1.116	(1.249)

Table IV: Full model, mediation specifications 1 and 2 estimated coefficients

evidences of cancer screening avoidance and the previously stated rationale, it may also make sense that being objectively at risk "discourages" women to screen regularly (Kash et al. (1992) for example).

5.2 Auxiliary equation estimations

This stage of the mediation identification is required to estimate the residuals of each auxiliary equation and then introduce them instead of their respective independent variables. Table V presents the results for each auxiliary equation in both mediation specifications. Women whose mother's went beyond compulsory education are more likely to hold a degree, be executive and risk tolerant. Women whose mothers are still alive tend to earn more. This effect can be explained by the inter-generational transmission of financial and health conditions. More educated women are more optimistic about their chances of developing BC relatively to less educated women even though 85% of them tend to overestimate their risk. This is consistent with Katapodi's analysis in which women who hold a degree tend to hold an optimistic bias. Richer women perceive to have a lower chance of being cured if they have BC but the opposite effect applies for executive women. More future oriented women are more likely to have private health insurance which is intuitively explained by a greater tendency to think about future consequences. The more a woman went often to a specialist doctor in the previous 12 months the more she thinks she has higher chance of developing BC but also the more she thinks she will be cured if she has one. Not being able to control for the type of specialist doctor prevents from drawing conclusions on who may have influence their beliefs. Women with specific beliefs on their risk (hypochondriacs for instance) may also visit specialist doctors more.

5.3 Mediation model estimations

Estimated coefficients of each mediation model are provided in the last two columns of Table IV. Auxiliary equations estimated residuals were introduced instead of the actual indepen-

	Mediation specification 1					Mediation specification 2	
Var.	**Educ.**	**Income**	**Executive**	**Present oriented**	**Risk tolerant**	**Risk perc**	**Benefit perc**
Mother's edu	0.145**	0.0279	0.244***	0.0425	0.195**	-4.727	3.305
	(0.0722)	(0.0748)	(0.0588)	(0.105)	(0.0798)	(3.587)	(3.466)
Mother alive	0.0110	0.139*	-0.0248	-0.124	-0.0109	-0.0716	5.021
	(0.0759)	(0.0787)	(0.0618)	(0.111)	(0.0840)	(3.600)	(3.477)
Father alive	-0.0219	-0.0520	-0.0287	-0.0984	0.0864	-3.409	1.612
	(0.0932)	(0.0967)	(0.0759)	(0.136)	(0.103)	(4.401)	(4.252)
						-13.60***	4.372
Educ.						(3.801)	(3.672)
						0.0496	-9.805***
Income						(3.552)	(3.431)
						0.0335	8.542*
Executive						(4.848)	(4.684)
						-1.173	-5.548*
Risk tolerant						(3.379)	(3.264)
						-3.488	2.315
Present oriented						(2.585)	(2.497)
Age 50-54 (ref)							
55-59	-0.0975	0.0136	-0.00277	0.168	-0.0491	0.905	-1.648
	(0.0954)	(0.0989)	(0.0777)	(0.139)	(0.106)	(4.520)	(4.366)
60-64	-0.0559	-0.233**	-0.147*	0.151	-0.0947	-0.293	-0.629
	(0.108)	(0.112)	(0.0877)	(0.157)	(0.119)	(5.180)	(5.004)
65-74	-0.432***	-0.296**	-0.233**	0.0858	-2.31e-05	-12.43**	1.944
	(0.124)	(0.129)	(0.101)	(0.181)	(0.137)	(6.092)	(5.885)
Objective risk	0.0239*	-0.0345**	-0.00372	0.0110	-0.00515	2.189***	-0.790
	(0.0136)	(0.0141)	(0.0111)	(0.0198)	(0.0150)	(0.634)	(0.612)
2-4 SP visits (ref)							
0 or 1 visit	-0.117	0.0442	-0.0302	-0.0600	0.0204	-6.586*	-0.582
	(0.0784)	(0.0813)	(0.0638)	(0.114)	(0.0867)	(3.685)	(3.560)
5 + visits	0.0612	0.133	0.0562	-0.110	-0.0538	0.421	6.764
	(0.119)	(0.124)	(0.0972)	(0.174)	(0.132)	(5.621)	(5.430)
2-4 GP visits(ref)							
0 or 1 visit	0.0447	-0.108	-0.0109	0.157	-0.0297	1.467	2.413
	(0.0912)	(0.0946)	(0.0743)	(0.133)	(0.101)	(4.328)	(4.181)
5 + visits	-0.0542	-0.199**	-0.0862	0.280**	-0.0785	3.733	-1.661
	(0.0904)	(0.0937)	(0.0736)	(0.132)	(0.1000)	(4.375)	(4.227)
Paris	0.0429	-0.0869	0.0684	-0.0239	0.120	1.225	-3.968
	(0.0791)	(0.0821)	(0.0645)	(0.115)	(0.0876)	(3.758)	(3.631)
Chronic disease	-0.0758	-0.134	-0.109	0.127	0.110	-2.439	-2.826
	(0.0836)	(0.0867)	(0.0681)	(0.122)	(0.0925)	(4.011)	(3.875)
Health insu	0.00336	0.0577	-0.0161	-0.102*	0.0111	0.123	2.147
	(0.0408)	(0.0423)	(0.0332)	(0.0595)	(0.0451)	(1.941)	(1.875)
Free	0.159**	0.0402	0.168***	-0.137	0.0989	-3.586	3.402
	(0.0717)	(0.0743)	(0.0584)	(0.105)	(0.0793)	(3.481)	(3.363)
Risk perc.	-0.00571***	-0.000602	-0.00133	-0.00179	-0.00182		
	(0.00164)	(0.00170)	(0.00134)	(0.00239)	(0.00181)		
Benefit perc.	0.00176	-0.00472***	0.00212	0.00172	-0.00274		
	(0.00169)	(0.00176)	(0.00138)	(0.00247)	(0.00187)		
Constant	0.573*	1.174***	0.268	2.960***	0.518	47.24***	61.85***
	(0.307)	(0.319)	(0.250)	(0.448)	(0.340)	(15.85)	(15.31)

Table V: Estimated coefficients of auxiliary equations of mediation specifications

dent variables in these models. For example, the estimated residuals of risk and benefit perceptions auxiliary equations are introduced in column 3 instead of the risk and benefit perception variables.

For the first mediation specification, there is a decrease in the magnitude of mother's education coefficient and an increase in the ones characterizing parents' vital status (but not statistically significant) when mediating variables are accounted for (column 2 compared with column 1). For the second mediation specification, there is a decrease in the magnitude of each coefficient characterizing the current social status when mediating variables are accounted for (column 3 compared to column 1). The effect of mother's education and current social inequalities are soften when the mediating variables are taken into consideration.

Disentangling the indirect effects from the direct effect in the mediating specification allows us to evaluate the relative importance of each one of them. The coefficient and standard errors of each direct and indirect effects are presented in table VI. All inferences are performed using the Sobel test provided in Kohler, Karlson and Holm (2011). In the first mediation specification, social background characteristics are not significantly associated with BC screening regularity. It essentially work through the level of education, their occupation and risk preference. More educated women have more educated daughters who are also more risk tolerant and therefore more likely to screen regularly. The indirect effect going through occupation is negative. Heavier time constraint and belief maybe an explanation.

Except from the direct effects of education and occupation reported before, the second mediation specification detects a negative indirect effect of education working through risk perception and an indirect effect of income working through benefit perception. These negative effects are explained by the fact that less educated women tend to overestimate their risk more (i.e. more pessimistic) than women holding a degree, and richer ones perceive less benefits than others. Therefore, not considering the mediation effect going via risk and benefit perceptions may lead to an overestimation of individual's social inequalities on BC screening attendance. Lastly, the level of education and income affect BC screening regularity both

directly and indirectly through perceptions.

6 Discussion and concluding remarks

This study adds to the existing literature by using experimental elicitation of risk preference and measuring time preference, risk and benefit perceptions to address the question of BC screening regularity (as opposed to the last BC screening performed).

Some limitations related to the use of experimental and survey methods must be acknowledged. First, the analysis relies on self-reported data which, given respondents anonymity, cannot be verified. It also implies the possibility of a response bias: respondents might have been concerned to report the motives they believed they ought to have had, rather than the ones they actually did have. However, those biases are limited due to their identities being hidden. Second, even though women were recruited in the less informative way with few details on the topic were provided to potential respondents, there may still be sample selection generated by word-of-mouth between women who participated. Women who are more comfortable with this topic due to regular cancer screening would be more willing to participate.

This study confirms the existence of social inequalities driven by educational attainment and the important contribution of risk and benefit perceptions in predicting screening consumption. However, perceptions do not seem to convey social inequalities. On the contrary, not taking into consideration these psychological variables would lead to an overestimation of what is attributable to education and income. Yet, allowing for these effects, one must acknowledge that this study does not tackle the potential endogeneity of risk and benefit perceptions.

This study also provides new empirical evidence on the positive relationship between risk tolerance and BC screening. The mediation analysis informed us of the process by which social inequalities are formed. Women whose mothers were educated are more likely to screen

	Direct effect	Indirect effects in mediation spe. 1					Indirect effects of mediation spe. 2		Total effect
		Via educ	Via Income	Via executive	Via risk pref	Via time pref	Via risk perc	Via benefit perc	
Social background									
Mothers'	-0.280	0.2008**	0.014	-0.241*	0.241**	-0.0093			0.0191
education	(0.296)	(0.108)	(0.036)	(0.121)	(0.109)	(0.0225)			(0.235)
Mother alive	0.0445	0.015	0.0701	0.024	-0.013	0.027			0.111
	(0.299)	(0.100)	(0.0546)	(0.059)	(0.0975)	(0.034)			(0.251)
Father alive	0.0292	-0.0302	-0.026	0.028	0.106	0.021			0.0644
	(0.353)	(0.129)	(0.049)	(0.078)	(0.1234)	(0.0306)			(0.307)
Current social characteristics									
Education	1.383***						-0.318**	0.063	0.969***
	(0.359)						(0.128)	(0.057)	(0.305)
Income	0.503*						0.011	-0.142*	0.256
	(0.289)						(0.078)	(0.0778)	(0.257)
Occupation	-0.989**						0.0007	0.123	-0.754*
	(0.434)						(0.106)	(0.0837)	(0.388)

Table VI: Indirect and direct effects of mediation specifications (1) and (2)

To read the table: The indirect effect of mothers' education working through her daughters education is 0.2008. It corresponds to the multiplication of the coefficient of the effect of mother's education on her daughter's education in the auxiliary equation (0.145) in table V by the coefficient of the effect of the individual education on screening regularity in the fist mediation specification (1.1383) in table IV.

regularly as they hold a degree and are risk tolerant. Parents social characteristics are beyond the control of individuals. Roemer (2009) therefore suggests that these inequalities of opportunities legitimate public interventions even more because of their higher degree of unfairness. To provide the public deciders with recommendations on how to compensate for these social inequalities, more research is needed to pin down the psychological mechanism at work behind the effect of risk tolerance on BC screening.

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Appendix A Mediation specification 2

The *total effect* of current social status on BC screening regularity where the potential mediating variables effects of risk and benefit perceptions are captured by the effect of current social status. Equation 7 represents the "reduced model" where mediating variables are left out:

$$Y_i = \alpha^{''} B_i + \beta^{'} E_i + \delta^{''} D_i + \sum_{k=1}^{2} (\pi_k^{'}.P_{k,i}) + \epsilon_{2,i} \tag{7}$$

The *total effect* of woman's current social status on BC screening regularity is measured by $\beta^{'}$ and its *direct effect* is measured by β (2). The difference between $\beta^{'}$ and β is the *mediating effect* or *indirect effect* of current social characteristics on BC screening working through perceptions. The same problem and solution than the one used for mediation specification 1 applies here. The auxiliary equations for each mediating variable are as follows:

$$\begin{aligned} X_{1,i} &= a_4 B_i + b_1 E_i + d_4 D_i + \sum_{k=1}^{2} (p_{k,1}.P_{k,i}) + z_{1,i} \\ X_{2,i} &= a_5 B_i + b_2 E_i + d_5 D_i + \sum_{k=1}^{2} (p_{k,2}.P_{k,i}) + z_{2,i} \end{aligned} \tag{8}$$

As in the first mediation specification, auxiliary equations are all estimated using linear probability models. The "full model" (Eq. 2) can then be rewritten as follows:

$$\begin{aligned} Y_i = \alpha B_i + \beta E_i + \delta D_i + \sum_{k=1}^{2} (\pi_k.P_{k,i}) + \gamma_1 (a_4 B_i + b_1 E_i + d_4 D_i + \sum_{k=1}^{2} (p_{k,1}.P_{k,i}) + \hat{z_{1,i}}) + \\ \gamma_2 (a_5 B_i + b_2 E_i + d_5 D_i + \sum_{k=1}^{2} (p_{k,2}.P_{k,i}) + \hat{z_{2,i}}) + u_{2,i} \end{aligned} \tag{9}$$

$$\begin{aligned} Y_i = (\beta + \gamma_1 b_1 + \gamma_2 b_2) E_i + (\delta + \gamma_1 d_4 + \gamma_2 d_5) D_i + \\ (\alpha + \gamma_1 a_4 + \gamma_2 a_5) B_i + (\sum_{k=1}^{2} \pi_k + \gamma_1 \sum_{k=1}^{2} p_{k,1} + \gamma_2 \sum_{k=1}^{2} p_{k,2}) P_{k,i} + + \gamma_1 \hat{z_1} + \gamma_2 \hat{z_2} + u_{2,i} \end{aligned} \tag{10}$$

Appendix B Price in the French screening system

Even though a free BC screening program exists in France since 2004, every woman is not confronted to the same price (aside from the transportation costs). A sizable proportion of targeted women are still screened opportunistically (outside of the program), as a result of their own or their GP and gynecologists' requests (10% of women opportunistically screened on average in 2010). These screenings are not usually performed following a clinical exam which detected a lump but as part of a preventive care scheme. In this case, they have to pay various amount - depending on the radiologist and potential extra exams performed. A positive price can also be due to extra exams as ultrasounds performed by the radiologist. These extra exams may not fully reimbursed (as highlighted in report produced by Barré and Hirtzlin (2010)) and induce out-of-pocket expenses for the patient. Hence, women are not confronted to the same financial costs so their belief on out-of-pocket expenses from BC screening may differ. An inverse relationship between the likelihood of participating in screening and its financial costs is expected. Markedly, organizers of the program reported that there is a "social services" label attached to the national screening program which serves it badly. More wealthy women would prefer to get screened outside the program since this label is according to them associated with bad quality.

Appendix C Sample Characteristics

The level of education is a binary variable which equals one if the respondent has tertiary education. Monthly pretax income of the household is grouped in two categories: less or more than 2500 euros. Occupational status is summarized by a binary variable which equals one if the woman is an executive. Mother's educational attainment is also a binary variable which equals one if she went beyond compulsory education. For women whose daughter's age are between 50 to 75 years old education was compulsory until 13 years old until 1936 and until 14 years old up to 1959. At these age they had just obtained the "Certificat d'Etude Primaire"

and sometimes went a little further in their studies. Parents' vital status correspond to binary variable which equal one if the parent is still alive. Almost all women (99%) who participated in our experiment live in the Ile-de-France region since the experiment took place in Paris and southern suburb. Parisian women may be specific regarding some aspects. They tend to favor opportunistic screening as 40% of screened women screen outside the program in 2010. This may be explained by doctors higher tendency to prescribe mammography outside the program. Access to GP and SP is rather favored by the high medical density of the capital city. So Parisian may be more prone to have faced positive price and be surrounded by more doctors. However, a lot of them applies extra-billing: one SP doctor out of two applies extra-billing in Paris. These characteristics describe the specificity of the Parisian medical environment which may affect Parisian women' consumption of BC screening. Additionally, being fully covered by health insurance due to chronic disease, having private health insurance are reported.

To check for sample representativeness, I compare the distribution of age, education level and private health insurance coverage among the sample with national figures. The sample is representative of the age distribution in France. But the level of education in our sample is not, our subjects are more educated. 22% of women in our sample have a master degree whereas national figure of 2012 indicated that 9.7% of women aged between 55 and 64 years old have a master degree. The sample is representative of health insurance coverage in France. All figures are available on the INSEE and ESPS websites.

Appendix D Choice of preference measures

Measuring these preferences in health decisions requires to make a trade-off between two ranges of issues. First, the combination of domain specificity and incentivised measure is difficult to implement in health decision. To our knowledge, the only real incentivised experiment investigating risk preference with lotteries in the domain of health is the study of

	Sample(%)	National Figure(%)
Higher degree obtained		
High school diploma or lower	43.26	80
University degree	56.74	20
Monthly pre-tax income of the household		
500-2500 euros	41.5	
2501 euros and more	58.5	
Executive		
Executive	19	
Other	81	
Age		
50−54 years old	23.4	23.5
55−59 years old	29.8	22.7
60−64 years old	24	22.47
65−69 years old	15	17.8
70−74 years old	8	13.5
Age	Mean: 60 (6.168)	
Parisian		
Parisian	33.5	
Living in the Suburb	66.5	
Visits to specialist in the last 12 months		
0-1 visit	40.5	
2-4 visits	50	
5+ visits	9.5	
Visits to GPs in the last 12 months		
O-1 visit	23.94	
2-4 visits	55.85	
5+visits	20.21	
Coverage for chronic disease		
100% coverage	23	
Has health insurance		
Has health insurance	91.5	94.7
Objective risk		
Mean proba. of devlopping BC	6.4	
Mother's education		
No education or certificat d'études primaires	60	
More than certificat d'études primaires	40	
Mother's alive		
Yes	50	
No	50	
Father's alive		
Yes	23	
No	77	

Table VII: Summary of individual characteristics of the sample

Kroll, Trarbach and Vogt (2011)). They used cold water to measure risk aversion related to physical pain. Lotteries' outcomes requires the subject to put her hand in a cold water bowl whose temperature could be regulated from 4 to 16 degree Celcius or for length of time between 2 to 12 minutes. As this type of measure couldn't be implemented in our design, a financially incentivised measure was preferred. Financially incentivised measures are context free and a monetary risk aversion measure would capture an exogenous personality trait. Several experimental measures with incentivised procedure elicit risk and time preferences. But, to select one of them, I was confronted to a second issue. The second issue is related to the measure of time preference with an incentivised measure. Eliciting time preference in an incentivised design implies delayed real payments. Given implementation difficulties (time scale, money transfers or additional cost to make women come back to get the money in several months), I could not use an incentivised measure for time preference. Instead, a psychological measure of time preference was used in the questionnaire. Fewer implementation constraints exist for the implementation of a measure of risk preferences because subjects are paid at the end of the experiment. The Consideration for Future Consequences scale is used. Its validity and stability have respectively been confirmed by factorial analysis and the test-retest method even with 8 items Petrocelli (2003) instead of the 12 items of the initial version. It has been found correlated with discount rates in Joireman et al. (2008). It was adapted and translated in French by Demarque et al. (2010) who also confirmed its validity in French and find similar results than those with the initial scale.

Appendix E Choice of perception measures

An ongoing literature debating on perceptions' measurement focuses on the advantage and inconvenient of verbal (scale with words indicating a quantity such as big and small) versus numerical measures (subjective probability of developing BC). On the one hand people have difficulties using numbers if limited by their numeracy level and on the other hand, verbal

measure allows for variability in how people interpret a word and therefore the range of probability it would encounter. Levy et al. (2006) tested three measures of risk perception of BC: verbal, numerical and comparative. After investigating the correlations between these measures, with a measure of actual risk (based on an epidemiological model) and screening behavior, they provide some support for the use of the numerical measure to capture risk perception. They don't find variation with education level, income and age groups.

To assess gratuity perception, out-of-pocket expenses is preferred to out-of-pocket spending (i.e. the amount after reimbursement) since making up-front payments generates the more vulnerable people to give up on seeking medical care. The exact amount was not used in the analysis since recalling exact amount is difficult and could lead to measurement error whereas a clear memory of whether they paid or not is less hazardous.